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FOREIGN TECHNOLOGY DIVISION

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by

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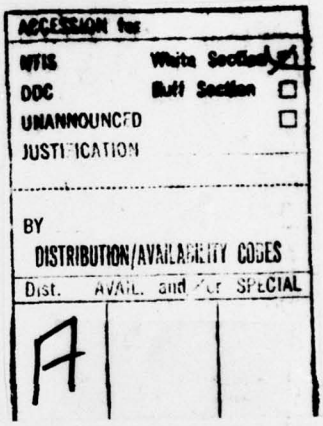

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STATUS OF DEVELOPMENT OF MARITIME TELECOMMUNICATIONS VIA SATELLITE

Along with other traditional man's activities merchant marine also came to the conclusion that increased volume of world trade requires adaptation of modern business methods. It has been shown that availability of fast and reliable communications is an essential factor in competitive capability of any firm on the international market.

The present status of the classical radio connections in maritime affairs is such that delays in trasmission of telegraph messages of up to 6 hours are regular, often they take up to 12 hours and sometimes they may take up to 36 hours. Because of an increasing number of users of the otherwise limited frequency spectrum assigned to maritime affairs the administrations of most of maritime countries are estimating that a choking of KV radio connections will take place by the end of the seventies. At the same time because of the presence of additional interferences, the quality of KV radio-telephone communications is unsatisfactory in 50-60% of the cases.

The fact that daily cost of a present day liner or container ship is in the order of US $ 10,000 and large losses that are thus caused to the shipowners by every day of delay due to failure to deliver messages, speak clearly of an unsatisfactory status with respect to standard potential of communications.

Basic needs of shipping require systems of transmissions that will assure fast connections and global caverage. At the same time they need improved quality of communications that would

enable direct and reliable transmissionsof teleprinted messages, radio-telephone connections and facsimili. It appears that such global requirements could be fulfilled by a system of transmissions i.e. by maintenence of radio communications, by use of communication satellites.

At the same time, it should be pointed out that presently widely used system of KV radio connections will not and should not dis appear overnight. In fact, development of equipment aimed at overcoming deficiencies of the KV radio connections is continuing with some success. A recent such example is equipment for correction of errors in telegraph trafic. This permits transmissionsof telex messages between ships on the sea and in international telegraph network, without errors. The so called LINKOPLEX installations have a similar objective to assure quality transmissions by use of radio-telephone connections.

INITIAL DEVELOPMENT AND DISTRIBUTION OF FREQUENCIES

The idea to use satellite technology to maintain contacts with moving units, airplanes and ships, appeared even before the end of the sixties, at the start of successful utilization of the INTELSAT intercontinental communication system by use of synchronous satellites. The first attempts were concerned with a division of the satellite communication system to satisfy simultaniously requirements of air and sea navigation. These represent a most effective use of A very expensive satallite segment.

First experiments and tests for possibility of maintaining maritime connections by satellites in the VHF and UHF bands gave encouraging results. Subsequent developments were therefore concerned with working out a system that would operate in the so called "L" frequency band.

The World Radio Administration conference held in 1971 in Geneva gave main impetus to accelerated development of maritime satellite systems by its special dedication to the problems of satellite radio communications. On that occasion, an international agreement was arrived at, assigning some commercially suitable frequencies exclusively for use in maritime satellite connections. On this conference the service for maintenece of radio connections of ships by satellites was given the official name MOVING MARITIME SATELLITE CONNECTIONS or short MARSAT. This service was assigned following frequency bands:

a) In the so called "L" frequency band, nominal 1600 MHz band, with the width of 7.5 MHz is assigned for maintaining commercial radio telegraph and radio telephone connections. Specifically, in the 1,535 - 1,542.5 MHz and 1,635.5 - 1,644 MHz. The lower frequency band is to be used for transmissions and connections from the satellite to the ship and the higher frequency band is to be used for transmissions from the ship to the satellite. In addition, two neighboring bands 1,542.5 - 1,543.5MHz and 1,644 - 1,645 MHz can be commonly used by ships and aircraft via the same satellites. The common bands are intended to enable providing help in cases of searching i.e. in cases of danger in either aeronautical or marine services.

The assigned frequncies are shown graphically in fig.1.

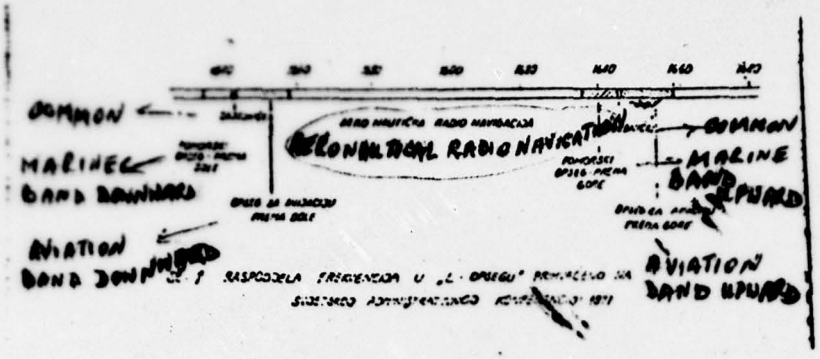


Fig. 1 Assignement of frequencies in the "L" band by the World Radio Administration Conference, 1971

Frequency bands used to maintain connections between satellites and coast stations which may intervene in providing maritime radio connections do not differ by their nature from other earth satellite services. Thus they use the same bands toward and from satellites. These are : 10.95 - 11.2 GHz, 11.45 - 11.7 GHz, 14.0 - 14.5 GHz, 17.7 - 21.2 GHz.

b. Though the initial experiments used VHF and UHF bands for maritime satellite connections, a significant use of these frequency bands for MARSAT connections did not materialize. The reason is the fact that these bands are already saturated with various other earth and marine services. Yet, it was felt that a certain narrow VHF frequency band, (via satellites) should be assigned to serve needs of navigation safety, orientation and warnings of danger.
The following two frequency bands have been allocated for this purpose : 157.3125 - 157.4126 and 161.9125 - 162.0125 MHz. These bands occupy a region of four duplex channels, no. 86, 27, 87, and 28 of the present VHF international marine radio telephone service. This will require a preassignement of the purposes of the mentioned channels which will be subject of discussions on one of the next international conferences on marine radio connections.

c) The following very narrow band of 406.0 to 406.1 MHz is reserved for construction of a radio beam system which, using relatively small energy, can be utilized simultaniously by ships and airplanes. This band, allocated in the frequency spectrum below the main communication band of 1,600 MHz, will be technically very suitable for use by small ships.

Unfortunately, it was not possible to allocate in this part of the frequency spectrum a broader band that could be used for regular communications with ships.

As a definite indication of expected fast development of satellite connections, it is of interest to note that following bands have been allocated to marine satellite services, including connections with ships : 43-48 GHz, 68-71 GHz, 95-101 GHz, 142-150 GHz, 190-200 GHz , 250-265 GHz.

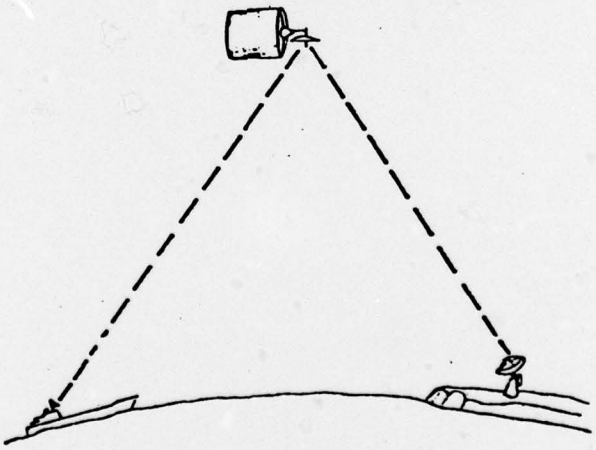
PROJECTS IN PROGRESS

After an international agreement about allocation of special frequency bands was reached, the efforts on development of a global system for marine radio connections via satellites have been intensified.

The first paractical steps were made during 1971 by USA Maritime Administration which together with industry carried out a program using nine ships which were initially equipped with experimental radio terminals using C band and then with radio installations which operated in the the assigned "L" frequency range. The experiments were made using research satellites ATS3/5 and ATS6 and were completed during the year 1973. The experiments have demonstrated the practical feasibility of satellite systems for communication with ships.

The next, step after the successful completion of the experiments, was to work out the first commercial system for maritime satellite communications. The system was named MARISAT and was scheduled to be put in operation by the end of 1975. This program anticipated placement of two identical satelites into a geo-stationary orbit and stationed in such a way in the universe that they would be capable of covering with their beams two oceans : Pacific and Atlantic. Corresponding coastal satellite stations were also to be constructed for receiving and connecting radio transmissions into land telephone and telegraph network.

An example of the principle of maintaining connections between coast stations on land and ships by use of a satellite is shown in fig 2. Fig. 3 shows positions of the two MARISAT satellites and the geographical areas of their coverage.



Sl.2 PRINCIP KORIŠTENJA SATELITA ZA POMORSKE VEZE

Fig. 2. Principle of use of satellites for maritime connections.

The contoures of coverage drawn in fig 3. are based on a ship antenna elevation angle of 5°, which is considered to be a lower practical limit. Two coastal stations are initially anticipated : a Pacific coastal station located in California and an Atlantic station built in Connecticut. This distribution of elements of the MARISAT system covers main maritime routes of the world with exception of a part of the Indian Ocean. It is estimated that only two satellites in their orbit can cover 80% of the ships on the sea.

Initial capacity of the MARISAT satellite are two voice channels for needs of the merchant marine. In the beginning of 1978 that capacity is to be increased to a total of 8 voice channels.

Simultanious with the MARISAT program, financed by interested administrations and industry which are potential manufacturers of ship-radio installations, the European Union for Investigation of Universe (ESRO) plans, studies and works on realization of an experimental but comprehensive maritime satellite system known under the name MAROTS (Maritime Orbiting Test Satellite).

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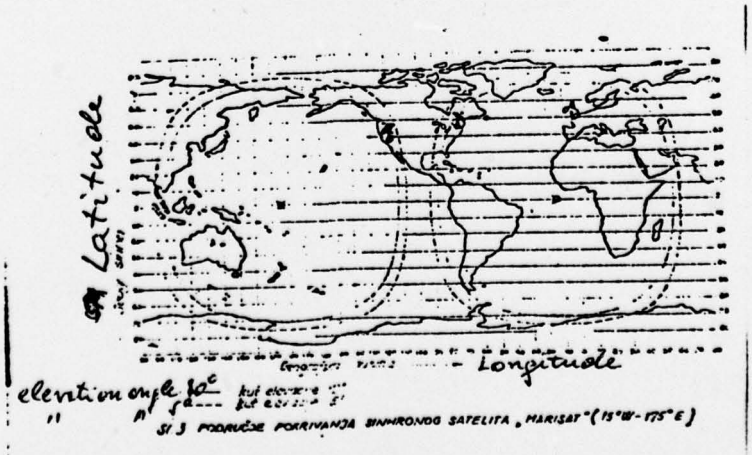

Fig. 3 Area of coverage for synchronous satellites "MARISAT" (150°W - 175°E)

It is expected that the MAROTS program will be put in operation by the end of 1977 with the launching of the first maritime satellite intended exclusively for merchant marine. The MAROTS satellite system is based on recommendations of organization IMCO (International Maritime Consulting Organization) which as an organ of the United Nations, serving as a consulting body for shipping associations and is analogous to the organization ICAO for aviation.

According to recommendations of the IMCO organization, the maritime satellite system should primarily resolve the problem of public communications with maritime units, it should achieve, as soon as possible, a global character, and should be based on satellites that have a seven years operational time. With respect to the capacity, IMCO determined that a minimal capacity of a satellite should be equivalent to 20 telephone channels. The methods of obtaining connections should enable gradual building up to a completely automatic control and automatic selection.

Though the MAROTS program tends to follow recommendations of IMCO organization as much as possible, it had to take into account the fact that its utilization will be gradual. Therefore, launching of only one satellite is initially anticipated. This satellite would assure coverage of the Atlantic Ocean and western part of the Indian Ocean, including the Persian Gulf. As may be observed from fig. the coverage of the Atlantic region is identical for both MARISAT and MAROTS projects because their universe segments (of satellites used for connections) are separated longitudinally by only 2.5°.

Location of administrative satellite stations has not as yet been defined, however, they could be located at any point covered by the satellite radiation. It is probable that a number of land or coast stations will be built and this will depend upon the specific commercial or political interests of individual European or other countries.

A satellite of the MAROT program will cover 45% of the territory in comparison with the project MARISAT, but its capacity will be considerably larger - a total of 14 voice channels.

In addition to the two main projects, on request of INTELSAT, the organization COMSAT is studying possibility of bulding special installations into INTELSAT V, a fifth generation of geo-stationary satelites for fixed land connections. This is a so called transponder for marine band which would be based on experiences obtained by practical use of the MARISAT system.

Realization of this program may be expected after the year 1980.

INFLUENCE OF SATELITE COMMUNICATIONS SYSTEMS ON MARITIME UNITS

Theoretical considerations and practical experiments obviously indicate that useful properties of satellite communication systems are considerably beyond possiblities of the classical SV and KV radio connections. The advantages that represent basic criteria in transmission of information : quality of connections, speed with which connections are established and reliability of connections, will be swiftly reflected in acceptance of the offered systems and outfitting the ships with completely new equipment and antennae installations. The possibility of automatic connections into the public TT network via coastal satellite stations by

← methods common in the public TT traffic will eliminate need for a special code, Morse code, in communications with ships.

Reliable teleprinting and a system of call selections will open possibilities of automatic telegraphic communications with ships in the same way in which the teleprinted messages are sent on land and can be received without presence of the personnel on duty. In this way the radio-telegraph operator is free from his obligation to listen to radio emissions and can take over more important servicing of complex electronic installations on the ship - aside from those that are located in the radiostation itself. The automatic control of various installations of the ship, particularly during the course of development of installation of maritime telecommunications, raises the question of the need to employ electronic technicians or the need to qualify the radio-telegraph operators for electronics, which appear to be a natural step.

In general, the satellite communication system as a global and reliable system for transmission of information will undoubtly have a most significant influence on the existing radio service which is devoted to safety of ships and human life on the seas.

Special frequencies allocated to this service, particularly in the VHF band, will enable construction of simple and reliable installations for automatic emission of distress signals. The volume of information emitted in such cases is so small that it can be transmitted in a very narrow frequency band. Consequently, the requirements for antennae and emission power are significatly simpler that those required for main communication stations.

Thus, in the near future, not only small ships will be equipped with reliable means for alarm in distress, but the same capability could be effectively utilized even by lifeboats.

The emitted distress signal will be received with certainty by corresponding installations of the coastal satellite stations which will continuously monitor (independent of the human factor) and automatically alarm proper rescue teams. Moreover, the capabilities of the satellite systems offer potential for a very fast and efficient way of determining goniometrically the position of any ship from one center and thus alarm just those ships that are in the immediate vicinity of the ship in distress.

Reliability and diversity of the maritime satellite systems will have very large influence on massive outfitting of ships with equipment for receiving facsimili - particularly meteorological and other charts. At the same time, it is certainly expected, that in order to improve the way of life on ships, some new services will be introduced, such as emissions of entertaining and educational character.

CONCLUSION

Because a satellite system has an essentially international character, it will be necessary for all services to be regulated by international agreements i.e. a common understanding of all countries will be needed about technical and exploitation characteristics of the system, method of operation of various services etc.

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Though the status of the maritime radio communications in Yugoslavia was recently (7-8 years ago) significantly improved, it would be a mistake to assume that a sufficient degree of

modernization has been achieved and that it is not necessary for our country to follow developments in maritime radio communications. The consequences in neglecting developments in maritime satellite communications for directing ships with modern means of communications would certainly reflect on competitive capability of the Yugoslav merchant marine. Therefore, we should at this time actively undertake studies of all aspects of the maritime satellite connections, particularly since there are a few simultanious projects in existence.

It is a compelling conclusion that a certain official organ, possibly the Yugoslav National Commitee for CCIR, together with shipping organizations, form a concrete program for study of this matter for our conditions. In this way we may develop realistic conditions to prepare our shipping by 1980 for including our maritime units into a unified maritime satellite communication system.

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